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Real-time shading

Marc Olano, Kurt Akeley, John C. Hart, Wolfgang Heidrich, Michael McCool, Jason L. Mitchell, Randi Rost

August 2004 ACM SIGGRAPH 2004 Course Notes SIGGRAPH '04

Publisher: ACM Press

Full text available: pdf(7.39 MB)

Additional Information: full citation, abstract

Real-time procedural shading was once seen as a distant dream. When the first version of this course was offered four years ago, real-time shading was possible, but only with oneof-a-kind hardware or by combining the effects of tens to hundreds of rendering passes. Today, almost every new computer comes with graphics hardware capable of interactively executing shaders of thousands to tens of thousands of instructions. This course has been redesigned to address today's real-time shading capabili ...

2 Level set and PDE methods for computer graphics

David Breen, Ron Fedkiw, Ken Museth, Stanley Osher, Guillermo Sapiro, Ross Whitaker August 2004 ACM SIGGRAPH 2004 Course Notes SIGGRAPH '04

**Publisher: ACM Press** 

Full text available: pdf(17.07 MB) Additional Information: full citation, abstract, citings

Level set methods, an important class of partial differential equation (PDE) methods, define dynamic surfaces implicitly as the level set (iso-surface) of a sampled, evolving nD function. The course begins with preparatory material that introduces the concept of using partial differential equations to solve problems in computer graphics, geometric modeling and computer vision. This will include the structure and behavior of several different types of differential equations, e.g. the level set eq ...

3 The elements of nature: interactive and realistic techniques

Oliver Deusen, David S. Ebert, Ron Fedkiw, F. Kenton Musgrave, Przemyslaw Prusinkiewicz, Doug Roble, Jos Stam, Jerry Tessendorf

August 2004 ACM SIGGRAPH 2004 Course Notes SIGGRAPH '04

Publisher: ACM Press

Full text available: pdf(17.65 MB) Additional Information: full citation, abstract

This updated course on simulating natural phenomena will cover the latest research and production techniques for simulating most of the elements of nature. The presenters will provide movie production, interactive simulation, and research perspectives on the

difficult task of photorealistic modeling, rendering, and animation of natural phenomena. The course offers a nice balance of the latest interactive graphics hardware-based simulation techniques and the latest physics-based simulation techni ...

4 High dynamic range imaging



Publisher: ACM Press

Full text available: pdf(20.22 MB) Additional Information: full citation, abstract

Current display devices can display only a limited range of contrast and colors, which is one of the main reasons that most image acquisition, processing, and display techniques use no more than eight bits per color channel. This course outlines recent advances in high-dynamic-range imaging, from capture to display, that remove this restriction, thereby enabling images to represent the color gamut and dynamic range of the original scene rather than the limited subspace imposed by current monitor ...

5 Collision detection and proximity queries

Sunil Hadap, Dave Eberle, Pascal Volino, Ming C. Lin, Stephane Redon, Christer Ericson August 2004 ACM SIGGRAPH 2004 Course Notes SIGGRAPH '04

**Publisher: ACM Press** 

Full text available: pdf(11.22 MB) Additional Information: full citation, abstract

This course will primarily cover widely accepted and proved methodologies in collision detection. In addition more advanced or recent topics such as continuous collision detection, ADFs, and using graphics hardware will be introduced. When appropriate the methods discussed will be tied to familiar applications such as rigid body and cloth simulation, and will be compared. The course is a good overview for those developing applications in physically based modeling, VR, haptics, and robotics.

6 Exploiting perception in high-fidelity virtual environments: Exploiting perception in high-fidelity virtual environments

Additional presentations from the 24th course are available on the citation page

Mashhuda Glencross, Alan G. Chalmers, Ming C. Lin, Miguel A. Otaduy, Diego Gutierrez July 2006 ACM SIGGRAPH 2006 Courses SIGGRAPH '06

Publisher: ACM Press

Full text available: pdf(5.07 MB) Additional Information: full citation, abstract, references mov(68:6 MIN)

The objective of this course is to provide an introduction to the issues that must be considered when building high-fidelity 3D engaging shared virtual environments. The principles of human perception guide important development of algorithms and techniques in collaboration, graphical, auditory, and haptic rendering. We aim to show how human perception is exploited to achieve realism in high fidelity environments within the constraints of available finite computational resources. In this course w ...

**Keywords**: collaborative environments, haptics, high-fidelity rendering, human-computer interaction, multi-user, networked applications, perception, virtual reality

7 Real-time volume graphics

Klaus Engel, Markus Hadwiger, Joe M. Kniss, Aaron E. Lefohn, Christof Rezk Salama, Daniel Weiskopf

August 2004 ACM SIGGRAPH 2004 Course Notes SIGGRAPH '04

Publisher: ACM Press

Full text available: 🔁 pdf(7.63 MB) Additional Information: full citation, abstract

The tremendous evolution of programmable graphics hardware has made high-quality real-time volume graphics a reality. In addition to the traditional application of rendering volume data in scientific visualization, the interest in applying these techniques for real-time rendering of atmospheric phenomena and participating media such as fire, smoke, and clouds is growing rapidly. This course covers both applications in scientific visualization, e.g., medical volume data, and real-time rendering, ...

8 Spatial augmented reality: Modern approaches to augmented reality

Oliver Bimber, Ramesh Raskar

July 2006 ACM SIGGRAPH 2006 Courses SIGGRAPH '06

Publisher: ACM Press

Full text available: pdf(2.45 MB) Additional Information: full citation, abstract, references

This tutorial discusses the Spatial Augmented Reality (SAR) concept, its advantages and limitations. It will present examples of state-of-the-art display configurations, appropriate real-time rendering techniques, details about hardware and software implementations, and current areas of application. Specifically, it will describe techniques for optical combination using single/multiple spatially aligned mirror-beam splitters, image sources, transparent screens and optical holograms. Furthermore, ...

Radiance interpolants for accelerated bounded-error ray tracing

Kavita Bala, Julie Dorsey, Seth Teller

July 1999 ACM Transactions on Graphics (TOG), Volume 18 Issue 3

Publisher: ACM Press

Full text available: pdf(888.58 KB)

Additional Information: full citation, abstract, references, citings, index terms, review

Ray tracers, which sample radiance, are usually regarded as offline rendering algorithms that are too slow for interactive use. In this article we present a system that exploits object-space, ray-space, image-space, and temporal coherence to accelerate ray tracing. Our system uses per-surface interpolants to approximate radiance both interactive and batch ray tracers. Our approach explicity decouples the two primary operations of a ray tracer—shading and visibility de ...

**Keywords**: 4D interpolation, approximation, data structures, error bounds, interactive, interval arithmetic, radiance, rendering, rendering systems, visibility

10 Image-based visual hulls

Wojciech Matusik, Chris Buehler, Ramesh Raskar, Steven J. Gortler, Leonard McMillan July 2000 Proceedings of the 27th annual conference on Computer graphics and interactive techniques SIGGRAPH '00

Publisher: ACM Press/Addison-Wesley Publishing Co.

Full text available: pdf(1.73 MB)

Additional Information: full citation, abstract, references, citings, index terms

In this paper, we describe an efficient image-based approach to computing and shading visual hulls from silhouette image data. Our algorithm takes advantage of epipolar geometry and incremental computation to achieve a constant rendering cost per rendered pixel. It does not suffer from the computation complexity, limited resolution, or quantization artifacts of previous volumetric approaches. We demonstrate the use of this algorithm in a real-time virtualized reality application running off ...

**Keywords**: computer vision, constructive solid geometry, image-based rendering, misc. rendering algorithms

11 Spatial augmented reality: a modern approach to augmented reality: Modern



approaches to augmented reality

Oliver Bimber, Ramesh Raskar

July 2005 ACM SIGGRAPH 2005 Courses SIGGRAPH '05

Publisher: ACM Press

Full text available: 📆 pdf(48.93 MB) Additional Information: full citation, abstract, references, index terms

This tutorial discusses the Spatial Augmented Reality (SAR) concept, its advantages and limitations. It will present examples of state-of-the-art display configurations, appropriate real-time rendering techniques, details about hardware and software implementations, and current areas of application. Specifically, it will describe techniques for optical combination using single/multiple spatially aligned mirror-beam splitters, image sources, transparent screens and optical holograms. Furthermore, ...

12 Efficient image-based methods for rendering soft shadows



Maneesh Agrawala, Ravi Ramamoorthi, Alan Heirich, Laurent Moll July 2000 Proceedings of the 27th annual conference on Computer graphics and

interactive techniques SIGGRAPH '00

Publisher: ACM Press/Addison-Wesley Publishing Co.

Full text available: pdf(11.36 MB)

Additional Information: full citation, abstract, references, citings, index terms

We present two efficient imaged-based approaches for computation and display of highquality soft shadows from area light sources. Our methods are related to shadow maps and provide the associated benefits. The computation time and memory requirements for adding soft shadows to an image depend on image size and the number of lights, not geometric scene complexity. We also show that because area light sources are localized in space, soft shadow computations are particularly well suited to im ...

**Keywords**: image-based rendering, raytracing, shadows

13 Realistic materials in computer graphics: Realistic materials in computer graphics



Hendrik P. A. Lensch, Michael Goesele, Yung-Yu Chuang, Tim Hawkins, Steve Marschner, Wojciech Matusik, Gero Mueller

July 2005 ACM SIGGRAPH 2005 Courses SIGGRAPH '05

Publisher: ACM Press

Full text available: pdf(18.24 MB) Additional Information: full citation, references

14 Rendering: Integration of geomorphing into level of detail management for realtime





Christopher Zach

April 2002 Proceedings of the 18th spring conference on Computer graphics SCCG '02

Publisher: ACM Press

Full text available: pdf(1.75 MB) Additional Information: full citation, abstract, references, index terms

Realtime rendering of scenes with discrete levels of detail (LOD) often suffers from noticeable visual changes between succesive frames. We propose geomorphing to obtain smoother animations while retaining quaranteed frame rates. Our level of detail management calculates a set of representations, that are well suited for some future time interval according to the predicted motion of the user. Thus, the rendering system has enough time to change the representations smoothly to the desired level o ...

Keywords: flyover setting, geomorphing, realtime rendering

15 A framework for realistic image synthesis

Donald P. Greenberg, Kenneth E. Torrance, Peter Shirley, James Arvo, Eric Lafortune, James A. Ferwerda, Bruce Walter, Ben Trumbore, Sumanta Pattanaik, Sing-Choong Foo August 1997 Proceedings of the 24th annual conference on Computer graphics and

interactive techniques SIGGRAPH '97

Publisher: ACM Press/Addison-Wesley Publishing Co.

Full text available: pdf(28.94 MB) Additional Information: full citation, references, citings, index terms

Keywords: light reflection, perception, realistic image synthesis

16 Radiosity and hybrid methods

László Neumann, Attila Neumann

July 1995 ACM Transactions on Graphics (TOG), Volume 14 Issue 3

Publisher: ACM Press

Full text available: pdf(2.06 MB)

Additional Information: full citation, abstract, references, citings, index terms, review

We examine various solutions to the global illumination problem, based on an exact mathematical analysis of the rendering equation. In addition to introducing efficient radiosity algorithms, we present a uniform approach to reformulate all of the basic radiosity equations used so far. Using hybrid methods we are able to analyze possible combinations of the view-dependent ray-tracing method and of the low-resolution radiosity-based method, and to offer new algorithms.

**Keywords**: Southwell algorithm, complete two-pass method, conjugated gradient method, convergence criteria, coupling method, distributed ray tracing, double-patch method, nondiffuse ambient term, photosimulation, radiosity method, rendering equation, residual image, separable reflectance

17 Global illumination of glossy environments using wavelets and importance

Per H. Christensen, Eric J. Stollnitz, David H. Salesin, Tony D. DeRose January 1996 **ACM Transactions on Graphics (TOG)**, Volume 15 Issue 1

Publisher: ACM Press

Full text available: pdf(5.00 MB)

Additional Information: full citation, abstract, references, citings, index terms, review

We show how importance-driven refinement and a wavelet basis can be combined to provide an efficient solution to the global illumination problem with glossy and diffuse reflections. Importance is used to focus the computation on the interactions having the greatest impact on the visible solution. Wavelets are used to provide an efficient representation of radiance, importance, and the transport operator. We discuss a number of choices that must be made when constructing a finite element alg ...

18 Combining hierarchical radiosity and discontinuity meshing

Dani Lischinski, Filippo Tampieri, Donald P. Greenberg
September 1993 Proceedings of the 20th annual conference on Computer graphics
and interactive techniques SIGGRAPH '93

Publisher: ACM Press

Full text available: pdf(543.28 KB) Additional Information: full citation, references, citings, index terms

Keywords: Mach bands, diffuse reflector, discontinuity meshing, global illumination, hierarchical radiosity, photorealism, quadratic interpolation, radiance function, radiosity, reconstruction, shadows, view-independence

Image-based rendering of diffuse, specular and glossy surfaces from a single image



Samuel Boivin, Andre Gagalowicz

August 2001 Proceedings of the 28th annual conference on Computer graphics and interactive techniques SIGGRAPH '01

Publisher: ACM Press

Full text available: pdf(642.94 KB)

Additional Information: full citation, abstract, references, citings, index terms, review

In this paper, we present a new method to recover an approximation of the bidirectional reflectance distribution function (BRDF) of the surfaces present in a real scene. This is done from a single photograph and a 3D geometric model of the scene. The result is a full model of the reflectance properties of all surfaces, which can be rendered under novel illumination conditions with, for example, viewpoint modification and the addition of new synthetic objects. Our technique produces a reflecta ...

Keywords: BRDF models, global illumination, image-based rendering, inverse rendering, radiance, radiosity, reflectance recovery, rendering, rerendering

620 Illumination from curved reflectors





Don Mitchell, Pat Hanrahan

July 1992 ACM SIGGRAPH Computer Graphics, Proceedings of the 19th annual conference on Computer graphics and interactive techniques SIGGRAPH

**'92**, Volume 26 Issue 2

Publisher: ACM Press

Full text available: pdf(3.27 MB)

Additional Information: full citation, references, citings, index terms

Keywords: automatic differentiation, caustics, differential geometry, geometrical optics, global illumination, interval arithmetic, ray tracing, wavefronts

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